Platinum Group Metal Recycling Technology Development (New FY 2004 Project)

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Objectives

- Develop environmentally friendly processes for recovering and recycling the platinum, palladium, rhodium and ruthenium present in fuel reformers and proton exchange membrane (PEM) fuel cell stacks.
- Investigate leaching, industrial microwave, supercritical carbon dioxide, and pyrometallurgical processes, and select the preferred processes for recovering precious metals from the various types of catalysts present in PEM fuel cell systems.
- Build and operate pilot equipment to demonstrate process viability.
- Estimate the economics of viable processes.

Technical Barriers

This project addresses the following technical barriers from the Fuel Cells section of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year R,D&D Plan:

Fuel Flexible Fuel Processors

- N. Cost

Component

- O. Stack Material and Manufacturing Cost

Approach

The primary objective is to develop and demonstrate the viability of processes for recovering and recycling the platinum, palladium, rhodium, and ruthenium present in fuel reformers and PEM fuel cell stacks. For the viable processes, pilot scale equipment will be built and operated to gather information needed to estimate process economics.

Several different types of catalysts are present in PEM fuel cell systems. The fuel reformers that are used to make hydrogen have catalyzed ceramic or metal substrates. Fuel cell stacks are sandwich structures made from membrane assemblies (typically composites of carbon cloth, catalysts and fluoropolymers) and bipolar plates. Different processes are required to recover and recycle the precious metals present in the different components of a PEM fuel cell system.

An environmentally friendly process will be developed for recovering precious metal from membrane electrode assemblies (MEAs). Simple

combustion of MEAs produces a Pt-rich ash that is hard to handle. This process also gives off significant amounts of toxic and corrosive hydrogen fluoride (HF) gas. Several new processes will be investigated including industrial microwave technology, conventional leaching, microwave-assisted leaching, and supercritical carbon dioxide leaching. The leaching processes are unlikely to generate HF, thus solving the HF emissions problem, and, at the same time, present an opportunity for recovering the fluoropolymer. Following the leaching, pyrometallurgical reprocessing will be used to increase precious metal yield and sequester the fluoride as an insoluble slag.

New processes will also be developed for recovering precious metal from the catalyzed ceramic and metal substrates present in a reformer. At present, ceramic-supported catalysts are ground up, and the precious metal is separated and concentrated using a pyrometallurgical process. A modified version of the currently used process will be developed to treat the slag and thereby increase precious metal yield. Pyrometallurgy is not well suited to recover the precious metal from reformer catalysts that are coated on metal supports such as metal monoliths, foams, and heat exchangers. A new process will be researched that delaminates the wash coat and treats the delaminate by conventional refining technology to recover precious metals.

In the third year of the project, the most promising processes will be designated for scale up. In the final three years of the project, pilot equipment will be built and operated to demonstrate process viability and gather information to estimate process economics.

The above work will take place over a 5-year period.